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BGP SPF for Virtual Transport Network (VTN)
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Abstract

A Virtual Transport Network (VTN) is a virtual underlay network which consists of a customized network topology and a set of network resource allocated from the physical network. In a network, multiple VTNs can be created to meet different service requirements, and services may be mapped to the same or different VTNs.

In networks where BGP Shortest Path First (SPF) is used to distribute the link-state information among network nodes, the information of VTNs needs to be distributed along with the basic network information. This document specifies the BGP SPF mechanisms with necessary extensions to distribute the VTN information and perform VTN-specific path computaton.

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1. Introduction

The concept of Virtual Transport Network (VTN) is introduced in [I-D.ietf-teas-enhanced-vpn]. A VTN is a virtual underlay network which has customized network topology and a set of dedicated or shared network resources. In a network, different VTNs may be created to meet different service requirements, and services can be mapped to the same or different VTNs.

[I-D.ietf-spring-sr-for-enhanced-vpn] describes the use of resource-aware segments [I-D.ietf-spring-resource-aware-segments] to build SR based VTNs. The SIDs of each VTN and the associated topology and resource attributes need to be distributed using the control plane. [I-D.dong-lsr-sr-enhanced-vpn] specifies the IGP mechanism and extensions to build a set of SR based VTNs. [I-D.dong-idr-bgpls-sr-enhanced-vpn] further specifies the BGP-LS mechanisms and extensions to advertise the VTN information in each

domain and the VTN information on the inter-domain links to the network controller, so that the controller could use the collected information to build the inter-domain SR VTNs.

In networks where BGP SPF is used to distribute the link-state information among network nodes, the VTN information needs to be distributed along with the basic network link state and TE information. And comparing with the Internal Gateway Protocols (IGPs), BGP SPF may have some advantage in supporting a relatively large number of VTNs. This document specifies the BGP SPF mechanisms with necessary extensions to advertise the information of VTNs. The proposed mechanism is applicable to segment routing with MPLS data plane (SR-MPLS), segment routing with IPv6 data plane (SRv6), and native IPv6 data plane.

1.1. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP14 RFC 2119 [RFC2119] RFC 8174 [RFC8174] when, and only when, they appear in all capitals, as shown here.

2. Applicability of VTN related BGP-LS Extensions to BGP SPF

2.1. Reuse of BGP-LS TLVs for BGP SPF VTN

As described in [I-D.ietf-lsvr-bgp-spf], the NLRI and TLVs of BGP-LS can be reused by BGP SPF, this section describes the TLVs which are defined in BGP-LS and can be reused in BGP SPF for the distribution of VTN related information.

According to [I-D.ietf-teas-enhanced-vpn], a virtual transport network (VTN) has a customized network topology and a set of dedicated or shared network resources. Thus a VTN can be defined as the combination of a set of network attributes, including the topology attribute and the network resource attribute. A VTN is associated with a Multi-Topology ID (MT-ID) and/or an Algorithm ID which are used to define the VTN topology and path computation constraints. In some cases, each VTN may be associated with a

separate MT-ID or a Flex-Algo ID. When the amount of VTNs in a network is large, as described in [I-D.dong-teas-enhanced-vpn-vtn-scalability], multiple VTNs may be associated with the same topology and/or algorithm, so that the amount of topology-specific path computation can be shared by a group of VTNs, this could help to reduce the computation overhead in the control plane.

[I-D.ietf-lsvr-bgp-spf] does not cover the usage of Multi-Topology or Flex-Algo with BGP SPF. While the mechanism in this document is based on Multi-Topology [RFC4915][RFC5120] or Flex-Algo [I-D.ietf-lsr-flex-algo] with BGP SPF for topology and/or algorithm

-specific link-state information distribution and path computation. For this purpose, the Multi-topology TLV as defined in [I-D.ietf-idr-rfc7752bis], the SR Algorithm TLV as defined [RFC9085], and the Flex-Algo Definition TLV as defined in [I-D.ietf-idr-bgp-ls-flex-algo] are reused for BGP SPF.

[I-D.ietf-lsvr-bgp-spf] does not explicitly describes the usage with Segment Routing data plane. To build SR based VTN, the SR-MPLS and SRv6 TLVs as defined in [RFC9085] and [I-D.ietf-idr-bgpls-srv6-ext] are reused for BGP SPF.

The VTN extensions to BGP-LS as defined in [I-D.dong-idr-bgpls-sr-enhanced-vpn] applies to BGP SPF as well. This section lists the TLVs which are reused by BGP SPF, the detailed format of the TLVs are described in [I-D.dong-idr-bgpls-sr-enhanced-vpn].

The BGP-LS Attribute TLVs which are defined in [I-D.dong-idr-bgpls-sr-enhanced-vpn] and reused with BGP-LS-SPF SAFI are listed as below:

- Virtual Transport Network Definition (VTND) TLV: This is used to advertise the association between the VTN and the topology ID and/or algorithm ID. It can be carried in BGP-LS attribute associated with a Node NLRI.

- VTN ID TLV: This is used to describe the identifiers of one or more VTNs a link belongs to. It can be carried in BGP-LS attribute which is associated with a Link NLRI, or it could be

carried as a sub-TLV in the L2 Bundle Member Attribute TLV.

- Link Attribute Flags TLV: This is used to specify the characteristics of a link, its functionality is similar to the IS-IS Link Attribute sub-TLV defined in [RFC5029]. It can be carried in BGP-LS attribute which is associated with a Link NLRI, or it could be carried as a sub-TLV in the L2 Bundle Member Attribute TLV.

- VTN-specific prefix-SID TLV: This is used to advertise the prefix-SID and its associated VTN. It can be carried in BGP-LS attribute which is associated with a Prefix NLRI.

- VTN-specific Adj-SID TLV: This is used to advertise the adj-SID and its associated VTN. It can be carried in BGP-LS attribute of the associated Link NLRI.

Further BGP-LS TLVs may be defined in [I-D.dong-idr-bgpls-sr-enhanced-vpn], their usage with BGP SPF will be specified in a future version of this document.

2.2. VTN Topology and Resource Distribution

In network scenarios where each VTN is associated with a unique MT-ID, The BGP-LS mechanisms used to distribute the VTN topology and resource information to the network controller are described in [I-D.xie-idr-bgpls-sr-vtn-mt]. Such mechanism can be reused for the distribution of VTN information with BGP SPF.

In network scenarios where each VTN is associated with a unique Flex-Algo ID, The BGP-LS mechanisms used to distribute the VTN topology and resource information to the network controller are described in [I-D.zhu-idr-bgpls-sr-vtn-flexalgo]. Such mechanism can be reused for the distribution of VTN information with BGP SPF.

In network scenarios where multiple VTNs are associated with the same <topology, algorithm> tuple, while each VTN has different resource attributes, the BGP-LS mechanisms which can be used to distribute the VTN topology and resource information to the network controller are

described in [I-D.dong-idr-bgpls-sr-enhanced-vpn]. Such mechanism can be reused for the distribution of VTN information with BGP SPF.

The Sequence Number TLV as defined in [I-D.ietf-lsvr-bgp-spf] MUST be carried in the BGP-LS attribute associated with the BGP-LS-SPF NLRI. If the Sequence-Number TLV is not received then the corresponding Link NLRI is considered as malformed and MUST be handled as 'Treat-as- withdraw'. An implementation MAY log an error for further analysis.

3. SPF Calculation for VTNs

[I-D.ietf-lsvr-bgp-spf] describes the mechanisms of using the BGP-LS-SPF Node, Link, and Prefix NLRI for shortest path computation. With the introduction of VTN, the same mechanism is used for the shortest path computation of each VTN. The path computation for a VTN is based on the topology attributes and the constraints specified with the MT-ID and/or Algorithm ID associated with the VTN. When multiple VTNs are associated with the same topology, the result of the shortest path computation based on that topology could be shared by these VTNs.

4. Security Considerations

This document introduces no additional security vulnerabilities to BGP SPF.

The mechanism proposed in this document is subject to the same vulnerabilities as any other protocol that relies on BGP SPF.

5. IANA Considerations

This document request no IANA actions.

6. Acknowledgments

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7. References

7.1. Normative References

[I-D.dong-idr-bgpls-sr-enhanced-vpn]
Dong, J., Hu, Z., Li, Z., Tang, X., and R. Pang, "BGP-LS Extensions for Segment Routing based Enhanced VPN", draft-dong-idr-bgpls-sr-enhanced-vpn-03 (work in progress), February 2021.

[I-D.ietf-idr-bgp-ls-flex-algo]
Talaulikar, K., Psenak, P., Zandi, S., and G. Dawra, "Flexible Algorithm Definition Advertisement with BGP Link-State", draft-ietf-idr-bgp-ls-flex-algo-07 (work in progress), June 2021.

[I-D.ietf-idr-bgpls-srv6-ext]
Dawra, G., Filsfils, C., Talaulikar, K., Chen, M., Bernier, D., and B. Decraene, "BGP Link State Extensions for SRv6", draft-ietf-idr-bgpls-srv6-ext-08 (work in progress), June 2021.

[I-D.ietf-idr-rfc7752bis]
Talaulikar, K., "Distribution of Link-State and Traffic Engineering Information Using BGP", draft-ietf-idr-rfc7752bis-08 (work in progress), July 2021.

[I-D.ietf-lsvr-bgp-spf]
Patel, K., Lindem, A., Zandi, S., and W. Henderickx, "BGP Link-State Shortest Path First (SPF) Routing", draft-ietf-lsvr-bgp-spf-15 (work in progress), July 2021.

[I-D.ietf-spring-resource-aware-segments]
Dong, J., Bryant, S., Miyasaka, T., Zhu, Y., Qin, F., Li, Z., and F. Clad, "Introducing Resource Awareness to SR Segments", draft-ietf-spring-resource-aware-segments-03 (work in progress), July 2021.

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119,

DOI 10.17487/RFC2119, March 1997,
<https://www.rfc-editor.org/info/rfc2119>.

[RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in RFC 2119 Key Words", BCP 14, RFC 8174, DOI 10.17487/RFC8174, May 2017, <https://www.rfc-editor.org/info/rfc8174>.

[RFC9085] Previdi, S., Talaulikar, K., Ed., Filsfils, C., Gredler, H., and M. Chen, "Border Gateway Protocol - Link State (BGP-LS) Extensions for Segment Routing", RFC 9085, DOI 10.17487/RFC9085, August 2021, <https://www.rfc-editor.org/info/rfc9085>.

7.2. Informative References

[I-D.dong-lsr-sr-enhanced-vpn]
Dong, J., Hu, Z., Li, Z., Tang, X., Pang, R., JooHeon, L., and S. Bryant, "IGP Extensions for Scalable Segment Routing based Enhanced VPN", draft-dong-lsr-sr-enhanced-vpn-06 (work in progress), July 2021.

[I-D.dong-teas-enhanced-vpn-vtn-scalability]
Dong, J., Li, Z., Gong, L., Yang, G., Guichard, J. N., Mishra, G., and F. Qin, "Scalability Considerations for Enhanced VPN (VPN+)", draft-dong-teas-enhanced-vpn-vtn-scalability-03 (work in progress), July 2021.

[I-D.ietf-lsr-flex-algo]
Psenak, P., Hegde, S., Filsfils, C., Talaulikar, K., and A. Gulko, "IGP Flexible Algorithm", draft-ietf-lsr-flex-algo-17 (work in progress), July 2021.

[I-D.ietf-spring-sr-for-enhanced-vpn]
Dong, J., Bryant, S., Miyasaka, T., Zhu, Y., Qin, F., Li, Z., and F. Clad, "Segment Routing based Virtual Transport Network (VTN) for Enhanced VPN", draft-ietf-spring-sr-for-enhanced-vpn-01 (work in progress), July 2021.

[I-D.ietf-teas-enhanced-vpn]

Dong, J., Bryant, S., Li, Z., Miyasaka, T., and Y. Lee, "A Framework for Enhanced Virtual Private Network (VPN+) Services", draft-ietf-teas-enhanced-vpn-08 (work in progress), July 2021.

[I-D.xie-idr-bgpls-sr-vtn-mt]
Xie, C., Li, C., Dong, J., and Z. Li, "BGP-LS with Multi-topology for Segment Routing based Virtual Transport Networks", draft-xie-idr-bgpls-sr-vtn-mt-03 (work in progress), July 2021.

[I-D.zhu-idr-bgpls-sr-vtn-flexalgo]
Zhu, Y., Dong, J., and Z. Hu, "BGP-LS with Flex-Algo for Segment Routing based Virtual Transport Networks", draft-zhu-idr-bgpls-sr-vtn-flexalgo-01 (work in progress), February 2021.

[RFC4915] Psenak, P., Mirtorabi, S., Roy, A., Nguyen, L., and P. Pillay-Esnault, "Multi-Topology (MT) Routing in OSPF", RFC 4915, DOI 10.17487/RFC4915, June 2007, <https://www.rfc-editor.org/info/rfc4915>.

[RFC5029] Vasseur, JP. and S. Previdi, "Definition of an IS-IS Link Attribute Sub-TLV", RFC 5029, DOI 10.17487/RFC5029, September 2007, <https://www.rfc-editor.org/info/rfc5029>.

[RFC5120] Przygienda, T., Shen, N., and N. Sheth, "M-ISIS: Multi Topology (MT) Routing in Intermediate System to Intermediate Systems (IS-ISs)", RFC 5120, DOI 10.17487/RFC5120, February 2008, <https://www.rfc-editor.org/info/rfc5120>.

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